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Risk taking and risk sharing: does responsibility matter?

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Abstract

Risk sharing arrangements diminish individuals' vulnerability to probabilistic events that negatively affect their financial situation. This is because risk sharing implies redistribution, as lucky individuals support the unlucky ones. We hypothesize that responsibility for risky choices decreases individuals' willingness to share risk by dampening redistribution motives, and investigate this conjecture with a laboratory experiment. Responsibility is created by allowing participants to choose between two different risky lotteries before they decide how much risk they share with a randomly matched partner. Risk sharing is then compared to a treatment where risk exposure is randomly assigned. We find that average risk sharing does not depend on whether individuals can control their risk exposure. However, we observe that when individuals are responsible for their risk exposure, risk sharing decisions are systematically conditioned on the risk exposure of the sharing partner, whereas this is not the case when risk exposure is random.

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1 Introduction

The fundamental premise for the support of safety nets, such as social security systems and private insurances, is that individuals are willing to share risk with others, thereby accepting the resulting redistribution of income. Indeed, whenever risk is shared those who are lucky support the more unlucky individuals in society.

For a long time, the idea of tailoring insurance rates to risk types has been debated in public.[1] For example, proposals to charge higher health insurance premiums to smokers and obese people have been advanced, with the motivation that a high proportion of health care costs can be directly attributed to patients' bad habits (see Cawley and Ruhm, 2011 and Thomson Reuters, 2011). In light of this evidence, we suggests that support for risk sharing arrangements is weak when individuals are perceived to be responsible for their risk exposure.

The decision to share risk may be backed by both insurance and redistribution motives. The first has a selfish nature, as it allows risk averse individuals to reduce their risk exposure. The second is driven by a preference for equality, as the more risk is shared the more income inequalities are reduced ex-post. We hypothesize that in the absence of responsibility attributions for risk exposure, redistribution motives are stronger and the willingness to share risk higher, as compared to when individuals can influence the risk they face. We test this conjecture using a controlled laboratory experiment, focusing on endogenous and exogenous differences in risk exposure. Our set up allows studying how the support for risk sharing depends on individuals' risk preferences, their own risk exposure, as well as their sharing partner's risk exposure.

Empirical research on risk sharing has identified a number of factors that affect individuals' propensity to share risk, e.g. group size (Chaudhuri et al., 2010), group selection and commitment (Barr and Genicot, 2008), risk preferences and social networks (Attanasio et al., 2012), one's own and others' risk profiles (Tausch et al., 2013) and reciprocity in repeated interactions (Charness and Genicot, 2007). However, to the best of our knowledge, we are the first to investigate how risk sharing depends on whether individuals perceive themselves and others to be responsible for the extent to which they are exposed to risk. Our results help to understand whether perceived choice responsibility is a crucial variable influencing the support of modern safety nets.

The experiment consists of two treatments. In the Exogenous Risks (EXO) treatment subjects cannot influence the extent to which they are exposed to risk, while in the Endogenous Risks (ENDO) treatment subjects can choose their risk exposure. In the first part of the ENDO (EXO) treatment subjects choose (are assigned) one of two risky lotteries. Both lottery options have the

[1]For recent articles see New York Times on the web, 2011, CNN on the web, 2011, The Washington Post, 2012.

same expected value but differ in their variance. In the second part of both treatments, subjects are paired and one subject in each pair is randomly selected to choose a risk sharing level. Importantly, the risk sharing decision is made ex-ante, that is before the lotteries' outcomes are determined. The risk sharing level indicates the percentage amount that will be subtracted from the eventual outcomes and then equally redistributed in the pair at the end of the experiment. We implement the strategy method, which means that participants are asked to choose a risk sharing level both for the case that their partner faces the same risk exposure as themselves, and for the case that risk exposures differ. In the last part of the experiment we use a series of incentivized lottery choices to elicit participants' risk preferences.

Our main result is that in ENDO individuals systematically condition their risk sharing decisions on the risk exposure chosen by their partner, while the risk sharing behavior of individuals in EXO does not depend on the partner's risk exposure. Further, we find that average risk sharing is not significantly different in EXO than in ENDO.

Our research is related to some experimental studies that investigate the support for ex-post income redistribution in contexts where individuals' outcomes are the product of risky decisions. In Cappelen et al. (2013) participants make choices between a risky lottery and a safe alternative and after observing the eventual outcomes, they are asked how much they want to redistribute to another randomly matched participant. The authors find that individuals who avoid risk do not redistribute much in favor of unlucky risk takers, while the willingness to reduce inequalities is higher between lucky and unlucky risk takers. Thral and Rademacher (2009) implement the solidarity game of Selten and Ockenfels (1998) and compare it to a treatment where individuals choose between a safe payment and a risky lottery. The authors show that individuals that choose the safe payment are less willing to reduce inequalities when matched with individuals that choose the lottery and become needy, as compared to individuals that become needy by pure chance. To summarize, it seems that risk taking is negatively perceived by individuals that avoid risk, and thus reduces their willingness to equalize earnings ex-post. Importantly, in the cited literature, redistribution decisions are made at a point when risk is resolved and individuals' outcomes are thus known. Our experiment allows testing whether responsibility for risky choices also matters when individuals face uncertainty about how risks eventually materialize. We believe that such an ex-ante perspective is worth investigating because most life outcomes are uncertain and hence, individuals often need to decide whether to support a given redistributing system before they observe their own outcome.

Our paper is also related to recent studies showing that income inequalities are more acceptable when they can be traced back to factors within peoples' control. Surveys, as well as experiments, reveal that support for redistribution is higher among people that think that wealth results from unjust motives, like luck or immoral behavior, as opposed to hard work, effort and skills (Alesina and Glaeser, 2004, Alesina and Ferrara, 2005, Fong, 2011, Durante and Putterman, 2009, Krawczyk, 2010). These results lend additional support for the idea that willingness to share risk may be related to whether risk exposure is perceived to be an exogenous factor or, on the contrary, an individual choice variable.

The reminder of the paper is organized as follows. Section 2 describes the experimental design. Section 3 summarizes theoretical predictions and hypotheses. Results are presented in Section 4. In Section 5 we discuss the results and conclude.

2 Experimental Design

We implement two treatments, EXO and ENDO, that differ with respect to whether subjects can choose the extent to which they are exposed to risk. Both treatments consist of three parts. In the following we describe each part in detail and point out the treatment differences.

In the **risk exposure** part all subjects in ENDO make a choice between two lottery options, while in EXO subjects are assigned one of the two lotteries by a random draw operated by the computer. Subjects face a lottery choice (ENDO) or a lottery assignment (EXO) in four situations, that differ in the available lotteries.[2] We employ more than one situation in order to test whether results are robust to different combinations of outcomes and probabilities. In each of the four situations participants are presented with two lotteries, R (high risk) and r (low risk).[3] Both lotteries yield a high outcome, H, with probability p and a low outcome, l, with probability $1 - p$. All the employed lotteries have the same expected value of €6, but in each situation the variance of lottery r is lower than that of lottery R.[4] In other words, lottery r second order stochastically dominates lottery R, and it is thus preferred by individuals with risk averse preferences. Keeping all lotteries' expected values equal ensures that situations differ only in one dimension, namely the difference in variance between lottery options. Hence, eventual differences in risk sharing across decision situations will be easier to interpret. Further, by abstracting from differences in expected values we obtain rather conservative results: in a given situation responsibility for risk taking is limited to the lottery's riskiness, as in expectation

[2] We also implemented a fifth situation where subjects choose between a safe payment and a risky lottery. The data referring to this situation are however not informative for our research question and are thus not included in the analysis of this paper.

[3] In the experiment a neutral wording is used. Please refer to the Appendix for the instructions used in the experiment.

[4] In situation II the expected value of r is €5.9. This exception was made to avoid confronting subjects with lottery outcomes that have more than one decimal point.

the contribution to the risk sharing pool is independent of the risk exposure. Table 1 gives an overview of the lotteries employed in the different situations. In each situation, probabilities and outcomes are selected in a way that participants can easily compare the two lotteries. In particular, lottery R and r are always equal in one dimension, either with respect to the outcomes' probabilities or with respect to the value of the lower outcome of the lottery, l.

Table 1 Situations in the risk exposure part

situation	option	p	H	l
I	R	0.2	30	0
	r	0.5	12	0
II	R	0.6	10	0
	r	0.6	6.5	5
III	R	0.2	22	2
	r	0.2	10	5
IV	R	0.2	14	4
	r	0.5	8	4

In situations I and II, the riskier option implies either a higher probability of ending up with a zero outcome or introduces the possibility of a zero outcome, as compared to the safer alternative. Situations III and IV are less extreme, in the sense that the low outcome of R is strictly larger than zero. We can thus test to what extent responsibility for risk exposure depends on the severity of the potential consequences of risk taking.

Situations are presented in random order to the participants. All participants are informed that only one of the five situations will matter for their final earnings. The instructions explain that each situation is equally likely to be selected for payment at the end of the experiment.

At the beginning of the **risk sharing** part subjects are randomly matched in pairs and in each pair one subject is selected at random to choose a risk sharing level $s \in [0, 100]$. The value of s has to be chosen *ex-ante* and represents the percentage amount that is deducted from the lottery outcome of each subject, after risk is resolved. In each risk sharing pair, the deducted amounts are added up and equally re-distributed at the end of the experiment. Higher values of s imply lower levels of earnings' inequality, with $s = 100$ leading to equal outcomes in a pair. The following expression defines the earnings of a subject i resulting from the first two parts of the experiment, where Y_i is the lottery outcome of i and Y_j is the lottery outcome of i's risk sharing partner, j. The lottery outcomes of i and j are uncorrelated.

$$\Pi_i = (1 - \frac{s}{100}) \cdot Y_i + \frac{\frac{s}{100} \cdot (Y_i + Y_j)}{2} \tag{1}$$

We employ the strategy method to elicit risk sharing levels. That is, for each of the four situations in the risk exposure part, a subject chooses two values of s. One for the case that the risk sharing partner faces the same lottery and one for the case that he faces the alternative lottery. Within a treatment, this allows observing whether individuals' risk sharing decisions are conditioned on the risk exposure of the risk sharing partner.

At the end of the experiment subjects are informed about the lottery chosen by (ENDO) or assigned to (EXO) their risk sharing partner. Further, the relevant risk sharing level is revealed to the subject who did not make decisions in the second part. Risk is then resolved, the chosen redistribution is implemented and earnings are determined. Instructions for the risk exposure and the risk sharing parts are administered together at the beginning of the experiment. Hence, in both treatments subjects know that decisions about risk sharing will have to be made after the risk exposure part.

Elicitation of Risk Preferences This part of the experiment is designed to estimate subjects' risk preferences. We use the multiple choice list method (Harrison and Cox, 2008) and elicit participants' certainty equivalents for the eight lotteries in Table 1. For each lottery subjects see a screen on the computer that contains a description of the lottery and a list of 20 equally spaced sure amounts, ranging from the lottery's high to its low potential outcome. In each row of the list subjects have to make a choice between the lottery and the sure amount. To ensure a unique switching point subject are not allowed to switch back and forth between the two. Certainty equivalents are then calculated as the arithmetic mean of the smallest sure amount preferred to the lottery and the consecutive sure amount in the list.

Experimental Procedures The experiment was conducted in the Behavioral and Experimental Economics Laboratory (BEElab) at Maastricht University. Subjects were recruited on line with the system ORSEE (Greiner, 2004). For the computerized implementation we used the experimental software Z-tree (Fischbacher, 2007). A typical session lasted approximately 1.5 hours and the average earnings were 18.70 Euro. In total 208 subjects participated in the experiment, 112 in the EXO and 96 in the ENDO treatment. In order to increase participants' understanding of the instructions a set of control questions was administered before the actual start of the experiment. Before being paid out and released participants were asked to fill out a questionnaire that gathered information on their socio-economic characteristics.

3 Predictions and hypotheses

Consider a subject i that is asked to choose how much risk he wants to share with subject j. If subject i is motivated by his own material interest, he will choose a risk sharing level s_i in order to maximize the expected utility of his earnings. Four states of the world k need to be taken into account: both subjects in the pair win, both lose, i wins and j loses, j wins and i loses. Formally stated:

$$\max_{s_i} \; EU_i = \sum_{k=1}^{4} p_k \cdot U(\Pi_{i,k}) \tag{2}$$

where p_k indicates the probability of the state of the world k and $U(\cdot)$ is the utility of i's final earnings, $\Pi_{i,k}$, in state k (see equation 1). The optimal risk sharing level s_i^* depends on the decision maker's risk preferences, as captured by the shape of $U(\cdot)$, and on the risk exposure of both individuals in the risk sharing pair. Hence, if subjects are self-interested, we should observe no significant difference in risk sharing in ENDO and EXO when risk exposure and risk preferences are taken into account. Further, the risk exposure of the sharing partner should influence risk sharing decisions in the same way in EXO and ENDO.

Abundant empirical evidence has demonstrated that, in contrast to the classical assumption of self-interested agents, a considerable fraction of individuals are characterized by a concern for others (see, for example, Camerer, 2003 and Forsythe et al., 1994). Moreover, many individuals are willing to support some degree of redistribution in favor of the less fortunate, even at a personal cost (see Fong, 2011, and Bowles, 2012). In our experiment, the more risk is shared the more eventual income differences between sharing partners are reduced. Hence, individuals' decisions to share risk may be influenced by their distributional preferences, with individuals sharing more the stronger their preference for equality. Among other factors, the strength of distributional preferences has been found to depend on the process that generates income. In particular, inequalities due to factors within individuals' control, such as effort, are perceived as largely justifiable, while more redistribution is observed when income differences are attributable to elements beyond peoples' influence, such as pure luck (see Alesina and Glaeser, 2004, Cappelen et al., 2007, Durante and Putterman, 2009 and Krawczyk, 2010). In our set-up, participants can influence their income in ENDO by actively choosing between two lotteries that differ in variance. In each situation, by choosing the riskier lottery they can potentially achieve the highest earnings. However, compared to its alternative, the riskier lottery at the same time entails either an increased likelihood of the bad state or a lower outcome in the bad state. In contrast to ENDO, individuals cannot influence their income in EXO as risk exposure is randomly assigned.

Since risk sharing entails redistribution, everything else equal, individuals' willingness to share risk may be higher in EXO as compared to ENDO. The strength of responsibility attributions in ENDO may however be weak, as risk sharing decisions are made *before* lottery outcomes are known, that is when only choices, but not their consequences, are observed. Thus, our first hypothesis is that average risk sharing is lower in ENDO than in EXO, but we do not expect this difference to be considerably large **[Hp1]**.

Cappelen et al. (2013) find that after risks are resolved, most individuals are not in favor of redistributing income from individuals who avoid risk to high risk takers that got a low outcome. At the same time most individuals are willing to eliminate ex post outcome differences resulting from differences in luck among risk-takers. This shows that individuals' preferences for redistributing income are affected by whether others choose to expose themselves to risk or not. Thral and Rademacher (2009) study how much individuals that choose a safe option are willing to transfer to individuals that instead choose a risk, and loose. The authors compare transfers to a situation in which all participants are exposed to risk, and find that subjects are less generous towards those whose bad outcome is a result of their risk-taking actions compared to those who could not influence their outcome. As this evidence suggests that responsibility for risk taking matters for redistribution preferences, we want to investigate whether responsibility attributions for risk exposure affect risk sharing in a similar manner. In particular, we hypothesize that low risk takers share less with high risk takers as compared to what they share with low risk takers, and that this difference is smaller in the EXO treatment **[Hp2]**. Employing the strategy method allows us to observe risk sharing decisions both for the case where the partner's risk exposure is high and low. Hence, we can test whether in ENDO individuals condition risk sharing decisions on their partner's risk exposure to a different extent as compared to EXO.

4 Results

We start our analysis by comparing average risk sharing between treatments and proceed by investigating risk sharing within treatments. In particular, we investigate how an individual's decision to share risk depends on his risk exposure and risk preferences, and on the risk exposure of the sharing partner. Before we present the results on risk sharing, we estimate participants' risk preferences using the elicited certainty equivalents from the third part of the experiment.

4.1 Elicited risk preferences

For the elicitation of participants' risk preferences we assume a power utility function for money $U(x) = x^{\alpha}$ and estimate the parameter value of $\alpha \in]0, \infty[$ at the individual level, by minimizing the sum of squared distances (see Wakker, 2008 and Wakker, 2010). That is:

$$\min_{\alpha} \sum_{n} [(p_n H_n^{\alpha} + (1 - p_n) l_n^{\alpha})^{\frac{1}{\alpha}} - ce_n]^2$$

where the first term in brackets indicates the theoretically predicted certainty equivalent for lottery n, and ce_n is the elicited certainty equivalent of lottery $n = 1, ..8$. To correct for heteroscedasticity lotteries are normalized to uniform length. We find that the median participant is characterized by $\alpha = 0.89$ (s.d. $\alpha = 0.41$, mean $\alpha = 0.93$). A majority of 67% of participants is risk averse. In the remainder we focus on the results regarding subjects that in the second part of the experiment are selected to choose the risk sharing levels.

Since options are randomly assigned in the EXO treatment, we observe no correlation between subjects' estimated risk preferences and the type of lotteries assigned to them (Spearman's rho=-0.01, p-value=0.96). In other words, in many cases an individual is exposed to a risk that is not in line with his risk preferences. On the other hand, in ENDO the estimated coefficient of risk aversion α is positively correlated with the number of times an individual chooses the riskier option in the risk exposure part (Spearman's rho 0.42, Pearson correlation 0.40, p-value< 0.05). This implies that the more an individual is risk seeking (averse) the more often he selects the riskier (less risky) lottery in the risk exposure part. Table 2 indicates, for each situation, the percentage of risk averse and risk seeking individuals that in the risk exposure part choose a lottery in line with their estimated risk preferences. From now on, we refer to those cases as 'consistent', and as 'inconsistent' otherwise.

Table 2 Risk preferences and risk exposure, ENDO

Situation	Choose r and $\alpha < 1$	Choose R and $\alpha > 1$
I	67%	50%
II	70%	39%
III	57%	72%
IV	60%	67%

In a majority of cases subjects choose a risk exposure in line with their estimated risk preferences, the occurrence of consistent behavior being especially high among risk averse individuals.

In the following analysis we present our results on risk sharing. For the interpretation of risk sharing decisions, in the EXO treatment we wish to control for whether subjects are exposed to a risk that is likely to be desirable for them, as this changes the incentives for sharing risk with others. To this end, we use individuals' estimated risk preferences. In the ENDO treatment elicited risk preferences are a good predictor of risk exposure choices: thus, we first conduct the analysis of risk sharing behavior taking only individuals' chosen risk exposure into account.

Successively, we also distinguish individuals based on whether their chosen risk exposure is in line with their estimated risk preferences.

4.2 Risk sharing

When averaging over all situations, we find that risk sharing is equal to 56% in EXO and lower in ENDO, with 50%. In order to test whether this difference is statistically significant **[Hp1]**, we run an OLS regression with risk sharing as the dependent variable, controlling for the risk exposure of both sharing partners and the decision maker's estimated risk preferences. We find that the coefficient of the treatment dummy is insignificant, and thus conclude that there are no significant differences in risk sharing levels between the ENDO and EXO treatment. All regression results are reported in the Appendix.

Result 1. *Average risk sharing is not significantly different when risk exposure is random as compared to when it is an individual choice.*

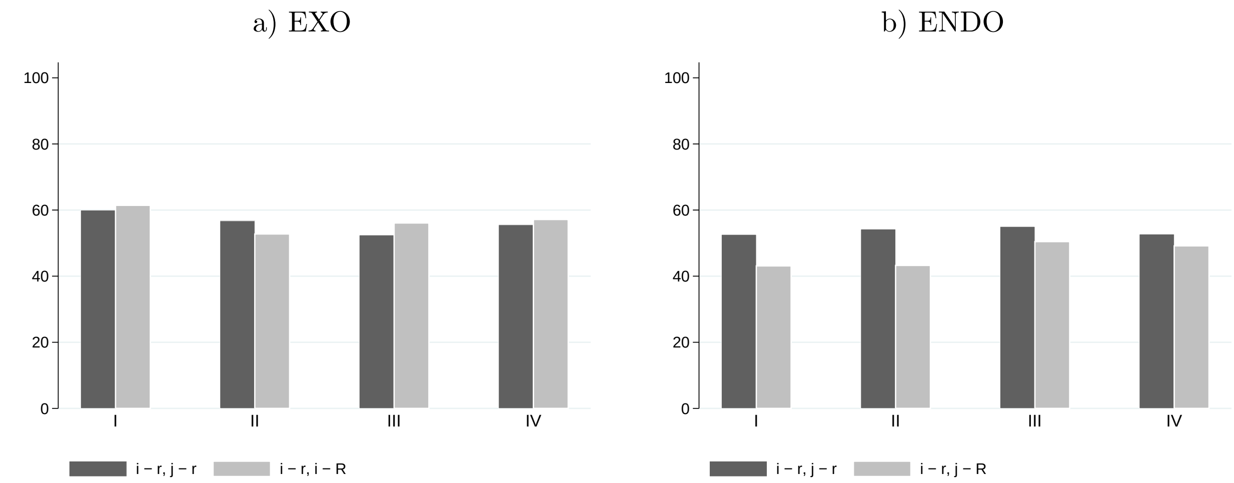
In order to test our second hypothesis **[Hp2]**, in the remainder we focus on the relation between risk sharing decisions and risk preferences. Since we employ the strategy method, we can apply a within-subject analysis. We compare individuals' risk sharing behavior when their sharing partner faces option r to the case where their partner faces the riskier option R.

We start by distinguishing individuals based on their risk exposure only and first look at those that were assigned (EXO) or chose (ENDO) the safer lottery r. Figure 1 shows average risk sharing in all situations separately for both treatments. The dark bars display average risk sharing levels in cases where both individuals i and j face option r, whereas the light bars represent average risk sharing when the sharing partner, j, faces option R instead.

Averaging over all situations, we find that in the EXO treatment risk sharing is 55% when the partner's option is r and 57% if it is R. A two-tailed Wilcoxon signed-rank test, henceforth WS, shows that these risk sharing levels are not significantly different (p-value=0.60). Results remain insignificant even when we only consider those subjects characterized by risk averse preferences, as measured by α (WS test p-value$\leq$ 0.24). This is important because it shows that results for EXO are not driven by the presence of individuals who are exposed to a risk that they would likely not have chosen by themselves. A WS test conducted for each situation separately confirms that when risks are exogenous, the partner's risk exposure is not related to risk sharing in a statistically significant way (WS test p-value$\geq$ 0.51).

Results are fairly different in the ENDO treatment. The average risk sharing level is 54% when the sharing partner chooses lottery r and only 45.5% in case the partner opts for lottery R. This difference is highly significantly different (WS test p-value=0.01). A systematic trend

Fig. 1 Average Risk sharing of subjects facing option r (%)



in behavior in all situations can be observed. Among individuals who choose r, less risk is shared on average when the partner chooses option R as compared to option r. The difference is statistically significant in situations I and II, in which high risk taking includes the possibility of a zero outcome (WS test p-values≤ 0.08). Results are not significant in situations III and IV (WS test p-values≥ 0.49). We thus conclude that *only* when risk exposure is deliberate, individuals condition their risk sharing behavior on their partner's risk exposure.

Result 2. *Individuals who choose to expose themselves to a low risk share less risk with a high risk taker as compared to someone who also makes a cautious choice. This difference is statistically significant when high risk taking includes the possibility of a zero outcome. When risk exposure is randomly assigned, individuals do not condition their risk sharing on their partner's risk exposure.*

We now conduct the same type of analysis for individuals that are assigned (EXO) or choose (ENDO) the riskier option R. We find that in both treatments and in all decision situations, individuals do not condition their risk sharing choices upon the risk exposure of their partner (WS test p-value≥ 0.25).[5] Average risk sharing in EXO is 53% when the partner is assigned r and 58% when the partner's option is R. The according values are 51% and 53% in the ENDO treatment.

Result 3. *Individuals that are exposed to a high risk neither condition their risk sharing on their partner's risk exposure when risk is endogenous nor when it is random.*

As anticipated in the previous section, our analysis proceeds by separating the cases where subjects choose (are assigned) a risk exposure in line with their estimated risk preferences from

[5]Figure **??** in the Appendix shows average risk sharing levels in both treatments.

those where this is not the case. This is especially interesting in order to understand risk sharing decisions in the ENDO treatment, as we find that subjects' behavior is systematically related to the consistency of the chosen risk exposure with the estimated risk preferences. This approach confirms that in the EXO treatment risk sharing decisions are never conditioned on the partner's risk exposure. Indeed, we do not observe any systematic trend both at aggregate level (WS test p-value≥ 0.41), as well as at the situation specific level (WS test p-value≥ 0.11) when we control for whether individuals face an option consistent with their estimated preferences. In the following we exclusively focus our attention to the analysis of risk sharing behavior when risks are endogenously chosen.

We first consider the cases where participants choose an option consistently with their estimated risk preferences. The importance of analyzing risk sharing behavior when choices are consistent is evident if considering that such choices are simply most frequent, as shown in Table 2. Further, many individuals display the same attitude towards risk across different domains (see Einav et al., 2012 and Dohmen et al., 2011) and hence, the following results are perhaps our most generalizable ones.

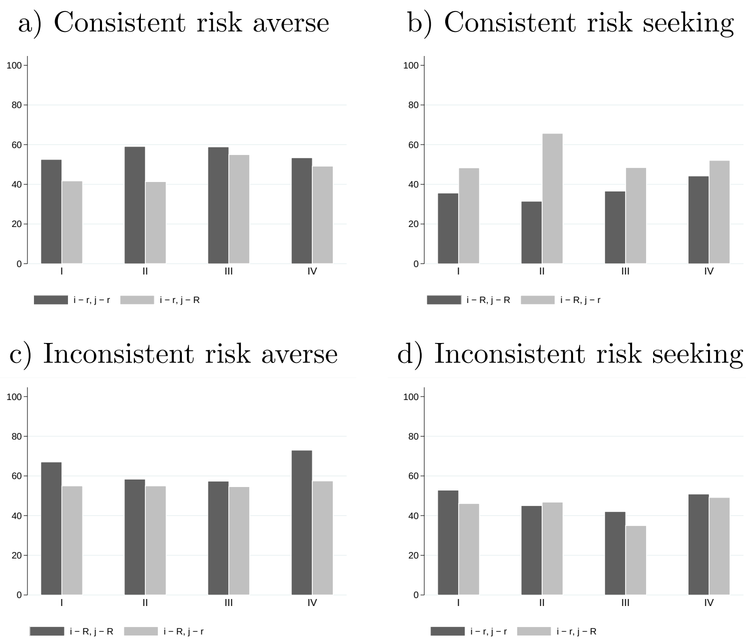
Among risk averse individuals that choose the low risk option r, the average risk sharing level is 58% when the sharing partner also chooses option r, but 10 percentage points lower when the partner chooses option R (WS test p-value$= 0.04$).[6] Figure 2 a) shows the average risk sharing levels in each decision situation.

In line with the results of the previous section, we find the same pattern of behavior in situations I to IV: i's willingness to share risk with j is lower when j chooses the riskier lottery, R. This difference is statistically significant in situations I and II (WS test p-value$= 0.08$ and 0.04, respectively). In situations III and IV differences are insignificant (WS test p-value≥ 0.4).

We now consider risk seeking participants that act consistently, and thus choose R. The average sharing level is 42% in case the sharing partner also chooses option R. In contrast, in case the sharing partner chooses option r, the average sharing level is 51% (WS test p-value$= 0.11$). Figure 2 b) shows that when risk seeking subjects act consistently, they systematically share more risks with subjects who choose the safe option. Differences are statistically significant at the 5% level in situation II. In the other situations, most likely because of the limited number of observations, differences are insignificant (WS test p-value≥ 0.16). In sum, risk sharing behavior of consistent risk seeking participants displays the same tendency as in cases where risk averse individuals choose consistently: facing a high risk taker as sharing partner reduces people's willingness to share risks.

[6] Our unit of observation is an individual's average risk sharing level calculated over those situations where the individual chose an option in line with his estimated risk preferences.

Fig. 2 Average risk sharing in ENDO taking consistency into account



Result 4. *When risk exposure is endogenous and individuals choose their risk exposure in a consistent way, they tend to share more risk with a partner that made a cautious choice as compared to a risky one.*

In the last part of the analysis we turn our attention to the cases where individuals in the ENDO treatment choose an option that is not in line with their estimated risk preferences. We will not try to provide an explanation of the observed inconsistencies, but rather focus on understanding risk sharing behavior in these cases. We begin by considering risk averse individuals who select option R. Risk sharing is on average 61% when their sharing partner also chooses option R. On the other hand, when the other member chooses option r, the average sharing level is 50%. Hence, in contrast to what is observed when risk averse individuals act consistently, they share less risk if their partner chooses option r (WS test p-value=0.14). Figure 2 c) shows the average sharing levels per situation. Note that in all situations i shares on average less risk when j chooses the safer option r as compared to when he chooses R. This difference is statistically significant in situation I and IV (WS test p-value=0.08 and 0.09 respectively). In the other situations differences are statistically insignificant (WS test p-value≥ 0.39). We conclude that in case generally cautious individuals select the riskier option they prefer to share more risk with individuals who make the same risky choice.

Result 5. *Risk averse individuals that decide to expose themselves to a high risk tend to share less risk with a cautious sharing partner as compared to a high risk taker.*

Lastly, we note that the behavior of risk seeking individuals that choose inconsistently does not present any systematic trend. The average sharing level is 46% when the sharing partner also chose option r and 45% when he chose option R (WS test p-value=0.78). There are no significant differences within situations (WS test p-value$\geq$ 0.20), as suggested by Figure 2 d).

To summarize, we find a lower willingness to share risk with high risk takers whenever individuals choose a risk exposure in line with their estimated risk preferences. However, when individuals deviate from their general risk preferences, they either do not condition their risk sharing on the partner's risk exposure or share more with high risk takers. Importantly, we find that none of the described effects emerges in the EXO treatment, that is when risk exposure is beyond individuals' control. Our results thus allow to conclude that responsibility for risk exposure matters for individuals' risk sharing decisions.

5 Discussion and Conclusions

In this study we experimentally investigate how individuals' support for risk sharing is related to whether risk exposure is deliberate or unswayable, to individuals' own risk preferences and to the risk exposure of the sharing partner.

Our main result is that when risk exposure is deliberate individuals are less willing to share risk with high risk takers as compared to low risk takers. When risk exposure is instead exogenous, risk sharing decisions are not conditioned on the risk exposure of the sharing partner. The observation that low risk takers' sharing decisions are affected by responsibility attributions carries important practical consequences for voluntary risk sharing arrangements. Indeed, in expectation, individuals who, for example, avoid unhealthy habits contribute more than high risk takers to the risk sharing pool. Hence, their support of risk sharing arrangements is fundamental for their sustainability. Interestingly, even in situations where individuals consistently take high risk they prefer to share more risk with those who choose a low risk exposure.

When averaging over all the different situations we analyze, we also find that risk sharing is higher, but not significantly so, when risk exposure is random as opposed to deliberate. This suggests that, compared to ex-post redistribution decisions, ex-ante decisions that carry redistribution effects may be less influenced by whether individuals outcomes are generated by deliberate risky choices. Another possible explanation is related to the fact that in our set-up responsibility is associated to choice under risk, while previous studies have compared income differences due to luck with those due to effort (see, for instance, Cappelen et al., 2007).

Importantly, our results can only be a lower bound of how much the support for risk sharing is a function of others' risk taking behavior. The riskier options in our set-up are characterized by potential outcomes that are more extreme in a negative and positive way, as compared to their safer alternatives. Thus, sharing risks with a high risk taker can be attractive, since it potentially allows to profit from a high income. However, habits like smoking, overeating and reckless driving hardly have positive externalities for society, as taking a high risk can at best increase the utility of the risk taker.

Taken together, our results suggest that measures that at least partly account for risk takers' responsibility for higher expected benefits from the system, such as raising smokers' health insurance premiums, may be desired. However, this is only the case if risk exposure is perceived as a choice. When risks are exogenous, for any risk preference, average risk sharing levels do not systematically vary with the risk exposure of the risk sharing partner. Thus, it seems that when risk is not a choice, redistribution motives may partly override self-interested insurance purposes. It remains an open question under which circumstances some preferences and behaviors are perceived as more exogenous, and thus less deserving to be condemned, than others (Bossert and Fleurbaey, 1996). An interesting avenue for future research would be to investigate how individuals' perception of choice responsibility can be influenced in order to promote support for risk sharing.

We conclude with a note on those situations where individuals who are generally cautious choose a high risk. The fact that these individuals share more with partners that made the same risky choice suggests that when they 'dare' to take risks they can better identify with other high risk takers. This identification effect may keep individuals from lowering risk sharing and, in contrast, induce them to even share more risk with the partner they identify with. This interpretation is suggested by studies showing a positive relationship between social identification and willingness to redistribute income (see Klor and Shayo, 2010, and Fowler and Kam, 2007). Further investigations are however needed to test the robustness of this effect.

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A Regression results and additional graphs

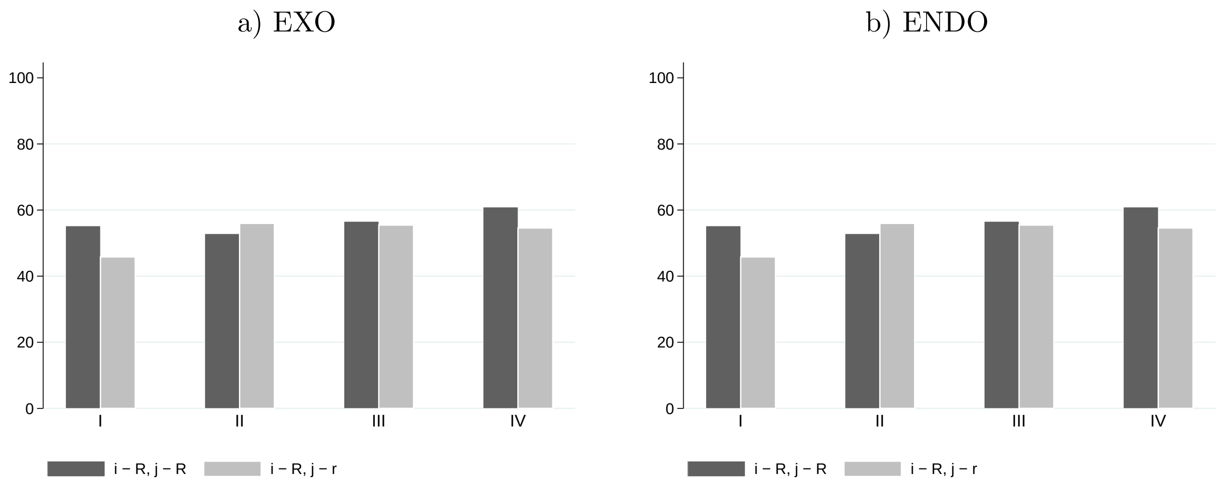
Table 3 Risk sharing level, treatment comparison.

Variable	**Coefficient**	**(Std. Err.)**
ENDO	-4.753	(3.752)
i-r, j-R	-3.638	(2.331)
i-r, j-R	-1.139	(3.396)
i-R, j-r	-2.018	(2.843)
alpha	1.758	(3.910)
Intercept	55.860***	(4.402)

N	832	
R^2	0.009	
$F_{(5,103)}$	.969	

Note: Standard errors are robust to heteroskedasticity and are clustered around subjects; the case i-r, j-r is the omitted treatment category; ENDO is a treatment dummy.

Fig. A.1 Average Risk sharing of subjects facing option R (%)



B Experiment Instructions

The following instructions appeared on participants' computer screens (exempt from the headlines in squared brackets).

Part 1 *[Risk exposure part]*
This is a screen shot of a typical decision situation that you are going to face. You are not asked to make choices now! Please have a careful look.

Fig. B.1 Screenshot risk exposure part

In this example, Option A yields 30 Euro with 20% chance and 0 Euro with 80% chance. Option B yields 12 Euro with 50% chance and 0 Euro with 50% chance. In order to choose between Option A and Option B you will have to tick one of the boxes surrounded by the red frame.
Assume, for instance, that the decision situation above is selected to be relevant for your payment and also assume that you chose Option B. It follows that at the end of the experiment a random draw will determine whether your outcome is 12 Euro or 0 Euro.
This outcome, together with the other decisions that you will make in this part of the experiment will determine your final earnings. In the following screens we will explain in detail how your earnings are affected by this outcome.

Part 1 (continued) *[Risk sharing part]*

After everyone has made choices between Option A and Option B, you will be randomly matched with another participant in the room. The two of you form a group. One person in the group (you or the other participant) will be randomly selected. For each of the 5 decision situations you faced before, the selected person has to choose a number between 1 and 100, which determines the individual outcome's percentage that each group member deposits in a group account.
At the end of the experiment, one decision situation will be randomly selected and the outcomes of the chosen options will be determined. Consequently, the amount in the group account will be calculated and equally divided between the two persons in the group. Notice that the selected person is asked to choose the percentage before the outcomes of the chosen options are known.

Assume, for instance, that you are selected to choose the percentages. In a given decision situation, you will have to make a choice before you know the outcome of the option you chose and before you know the outcome of the option chosen by the other person in the group.
Also notice that the selected person has to choose percentages for each of the 5 decision situations because the decision situation relevant for payment is only determined at the end of the experiment. Therefore, each choice has to be considered in isolation from the others, as if it were the one which is relevant for payment.
On the following screen the determination of earnings is illustrated with the help of examples.

Part 1 (continued)

Imagine now that you have been selected to choose the percentage.

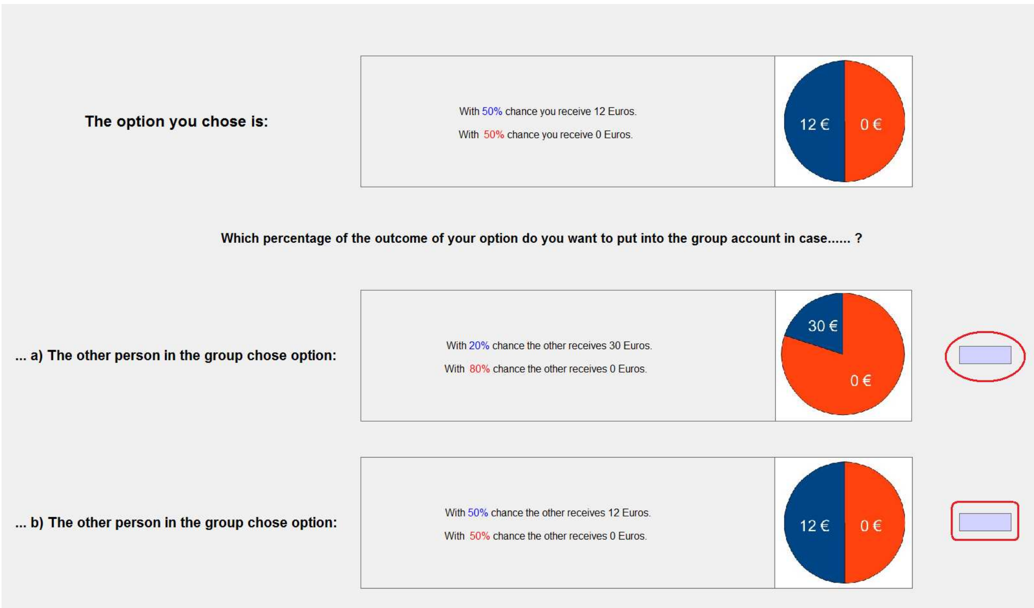
Example 1. Assume that both you and the other person in the group have chosen Option A, which in the preceding example yields 30 Euro with 20% chance and 0 Euro with 80% chance. Let's say that you choose the percentage value 40%. At the end of the experiment the

uncertainty concerning your earnings is resolved; assume that Option A eventually yields 30 Euro to you and 0 Euro to the other person. It follows that:
- The group account consists of 12 Euro (that is, 0.4*30+0.4*0=12+0).
- Your return from the group account is 6 (=12/2) Euro.
- Your earnings are 24 Euro (=30-12+6).
- The earnings of the other person in the group are 6 Euro (=0-0+6).

Example 2. Assume now that in the same decision situation you have chosen Option A, which yields 30 Euro with 20% chance and 0 Euro with 80% chance, and that the other person chose Option B, which yields 12 Euro with 50% chance and 0 Euro with 50% chance. Let's say that you choose the percentage value 70%. At the end of the experiment the uncertainty concerning your earnings is resolved. If Option A eventually yields 30 Euro to you and Option B yields 12 Euro to the other person. It follows that:
- The group account consists of 29.4 Euro (that is, 0.7*30+0.7*12=21+8.4).
- Your return from the group account is 14.7 (=29.4/2) Euro.
- Your earnings are 23.7 Euro (=30-21+14.7).
- The earnings of the other person in the group are 18.3 Euro (=12-8.4+14.7).

This is a screen shot of a typical decision situation that you are going to face. You are not asked to make choices now! Please have a careful look.

Fig. B.2 Screenshot risk sharing part



In case you are selected to choose the percentages, you are asked to do this twice for each decision situation. First, for the case that the other person in your group chose Option A (red circle) and second for the case that the other person in your group chose Option B (red square). When choosing the percentages you will not be informed about the actual option chosen by the other person in your group. At the end of the experiment the percentage associated to the actual choice of the other person in your group will be implemented. In other words, you will choose percentages for two possible scenarios. Since you do not know which one will be relevant for your payment, you have to make each choice in isolation and with the same accuracy.

Notice that your outcome may be different from that of the other person in your group even if both chose the same option.

Also notice that if you choose a percentage of 0 your earnings and the earnings of the other person in the group will exclusively depend on the individual outcome of the option that each of you chose. Conversely, if you choose a percentage of 100 your earnings and the earnings of the other person in the group will be equal to each other, as they will be the sum of your outcomes divided by 2.

Part 2 *[Elicitation of risk preferences]*

You are now going to make a series of decisions. These decisions will not influence your earnings from the first part of the experiment, nor will the decisions you made in the first parts of the experiment influence the earnings from this part. Furthermore, the decisions you are going to make will only influence your own earnings.

You will be confronted with 9 decision situations. All these decision situations are completely independent of each other. Each decision situation is displayed on a screen. The screen consists of 20 rows. You have to decide for every row whether you prefer Option A or Option B. Option A is the same for every row in a given decision situation, while Option B takes 20 different values, one for each row.

Note that within a decision screen you can only switch once from Option B to Option A: if you switch more than once a warning message will appear on the screen and you will be asked to change your decisions.

This is a screen shot of a typical decision situation that you are going to face. You are not asked to make choices now! Please have a careful look.

Determination of earnings

At the end of the experiment one of the 9 decision situations will be randomly selected with equal probability. Once the decision situation is selected, one of the 20 rows in this decision situation will be randomly selected. The choice you have made in this specific row will determine your earnings.

Consider, for instance, the first screen shot that you have seen. Option A gives you a 50%

Fig. B.3 Screenshot risk preferences elicitation

chance to earn 12.- Euro and a 50% chance to earn nothing. Option B is always a sure amount that ranges from 12.- Euro in the first row, to 0.6 Euro in the 20th row. Suppose that the 12th row is randomly selected. If you would have selected Option B, you would receive 5.4 Euro. If, instead, you would have selected option A, the outcome of the lottery determines your earnings. At the end of the experiment the lottery outcome will be determined by the computer.

Please note that each decision situation has the same likelihood to be the one that is relevant for your earnings. Therefore, you should view each decision independently and consider all your choices carefully.